INTERNATIONAL

ASSOCIATION FOR TESTING MATERIALS.

AMERICAN SECTION.

BULLETIN No. 8. MAY, 1900.

PROPOSED STANDARD SPECIFICATIONS

FOR

STRUCTURAL STEEL FOR BRIDGES AND SHIPS.

RECOMMENDED BY AMERICAN BRANCH OF COMMITTEE NO. 1, MAY 1, 1900.

There will be a discussion of these specifications at the Third Annual Meeting of the American Section, to be held in New York, on October 25-27, 1900, and you are requested to send in your views by letter, or to be present and take part in the oral discussion.

After the Annual Meeting, Committee No. 1 will consider the points raised, and make any modifications that may be found necessary; and, if so decided at the Annual Meeting, the specifications will be sent to all members of the American Section for approval by letter ballot.

If the other countries perform their work in the same general manner, the final work of the introduction of International Specifications will be reduced to a very simple matter, as there will only be a limited number of specifications to consider instead of hundreds as at the present time.

WM. R. WEBSTER,

Chairman of American Branch of Committee No. 1.

Process of Manufacture.

1. Steel shall be made by the open-hearth process.

Chemical Properties.

2. Each of the three classes of structural steel for bridges and ships shall conform to the following limits in chemical composition :

	Steel made by the acid process. Per cent.	Steel made by the basic process. Per cent.
Phosphorus shall not exceed.....	0.08	0.06
Sulphur shall not exceed.....	0.06	0.06

Physical Properties.

3. There shall be three classes of structural steel for bridges and ships, namely : RIVET STEEL, SOFT STEEL, and MEDIUM STEEL, which shall conform to the following physical qualities :

Classes.

4.

Tensile Tests.

	Rivet steel.	Soft steel.	Medium steel.
Tensile strength, pounds per square inch	50,000 to 60,000	52,000 to 62,000	60,000 to 70,000
Yield point, in pounds square inch, shall not be less than.....	30,000	32,000	35,000
Elongation in per cent. eight inches shall not be less than....	26	25	22

5. For material less than five-sixteenths inch (5/16″), and more than three-fourths inch (3/4″) in thickness, the following modifications shall be made in the requirements for elongation :

Modifications in elongation for thin and thick material.

(*a*). For each increase of one-eighth inch (1/8″) in thickness above three-fourths inch (3/4″), a deduction of one per cent. (1%) shall be made from the specified elongation.

(*b*). For each decrease of one-sixteenth inch (1/16″) in thickness below five-sixteenths inch (5/16″), a deduction of two and one-half per cent. (2 1/2%) shall be made from the specified elongation.

Name and Date.	Chemistry A = Acid O. H. B = Basic O. H.					Annealing Specimens.	Tensile strength, pounds per sq. inch.			Elastic limit, pounds per sq. inch.		
	Phos.	Sul.	Sil.	Mn.	Remarks.		Soft.	Medium.	Rivet.	Soft.	Medium.	Rivet.
Association American Steel Manufacturers, July 17, 1896	.08 .10	Bess. or O. H.			R.R. bridges. Hy. br. and bldg.	Annealed specimens for material that is to be annealed.	52,000 62,000	60,000 70,000	48,000 58,000	½ ult. "	½ ult. "	½ ult. "
Atchison, Topeka & S. F., Oct., 1895	.08						54,000 62,000	60,000 68,000		32,000	36,000	
Baltimore & Ohio, 1896	.08A .05B					Annealed specimens for material that is to be annealed	52,000 60,000	60,000 64,000		28,000 or ½ ult.	32,000, or ½ ult.	
B. & O. Southwestern, 1898	.08 .06	.06 .05			A. or Bess. B		4,000 62,000	60,000 70,000		33,000	32,000	
Boston, City of, 1899	.08A .06B				Rivet steel. Phos. .06			60,000 68,000	48,000 58,000		½ ult.	½ ult.
Buffalo, Rochester & Pgh, 1898	.06A .04B	.05A .04B	.05	.60		Annealed specimens for material that is to be annealed	50,000 60,000	60,000 68,000		55% ult., 1 in. and less. 50% ult. over 1 in.	55% ult. 1 in. and less. 50% ult. over 1 in.	
Cin., N. O. & Tex. Pacific Ry., July, 1898	.04A .03B	.02	.05	.60	Med. Phos. .05A " " .03B		52 000 62,000	62,000 70,000		32.000	35,000	
Theo. Cooper, 1896		Bess. or O.H.				Annealed specimens for material that is to be annealed.	54,000 62,000	60,000 68,000	50,000 58,000	½ ult.	½ ult.	½ ult.
Chicago & Northwestern, 1899	.08A .04B	.04A .04B					50,000 60,000	60.000 70,000	48,000 58,000	½ uit.	½ ult.	½ ult.
C. M. & St. P. Ry., 1898	.08A .05B	.05A .05B						55,000 65,000	47,000 57,000		½ ult.	½ ult.
C. M. & St. P. Ry., June 14, 1898	.08A .05B	.05A .05B						60,000 68,000	48,000 56,000		½ ult.	½ ult.
Illinois Central Ry., 1899	.08A .04A	.04A .04B					50,000 58,000	58,000 66,000		30,000	34,000	
King Bridge Co	.10	Bess. or O. H.					52.000 62,000	60,000 70 000		½ ult.	½ ult.	
L. S. & M. S. Ry., June, 1894	.08A .04B						56,000 64.000			60% ult.		
Missouri Pacific Ry., Jan. 1, 1899	.10	Bess. or O. H.					54,000 62,000	60,000 68,000		32,000	34,000	
N. Y. C. & H. R. R. R., 1899	.08A .04B	.05				Annealed specimens for material that is to be annealed.	56,000 64,000	62,000 70,000	48,000 56,000	60% ult., ⅝ in. t and under. 5⅛ ult. over ⅝ in.	60% ult.	
Northern Pacific Ry., Dec. 1, 1898	.08A .04B						52,000 60,000	62.000 70 000		30,000	37,000	
Osborn Co., R.R. bridges, 1896	.08A .04B	.05B					52 000 62,000	60,000 70,000		31,000	35,000	
Osborn Co., highway bridges, 1895	.08A .04B	.05B					52,000 62,000	60,000 70,000		31,000	35,000	
Pennsylvania Lines West of Pittsburgh, April, 1897	.08A .04B						54,000 62,000	62.000 70.000	52,000 58,000	55% ult.	55% ult.	55% ult.
Pennsylvania Railroad, Jan 1, 1897	.06A .04B					Not annealed.	52.000 62,000	62,000 70,000	48,000 56,000	28,000	33,000	28,000
J. A. L. Waddell	.05A .03B	.04	.04	.60	Soft. see remarks	Annealed specimens for material that is to be annealed.	50.000 60,000	60,000 70,000		30,000	35,000	
Canadian Pacific Ry., 1898	.065			.50				58,000 65,000			33,000	
Grand Trunk Ry., Nov. 17, 1897	.08A .04B					Annealed sample for material that is to be annealed.	54,000 62,000	60 000 68,000		½ ult.	½ ult.	
Dominion Government, 1899	.08A .04B	.04A .04B					50,000 58,000	60,000 68,000		30,000	32,000	
Mexican Central, 1898	.04					Annealed sample for material that is to be annealed		60.000 68.000	50,000 56,000		½ ult.	
C. B. & Q. Ry., 1898	.08A .05B						52,000 62,000	60.000 70,000		½ ult.	½ ult.	
Great Northern Ry., Mar. 1, 1898	.08A .04B				Bess. Phos. .06		52,000 62,000	60,000 70,000	48,000 56 000	55% ult.	55% ult.	55% ult.
Michigan Central Ry. 1899	.075A .04B	.04 med.			Soft. Phos. and sul. .04		50,000 60,000	57,000 66.000		55% ult.	55% ult.	
Southern Railway, 1897	.08A .05B						52,000 62,000	60.000 70,000	48,000 58,000	28,000	32,000	23,000
Union Pacific Ry, 1898	.06A .04B	.05A .05B					50,000 58,000	60,000 68 000		½ ult.	½ ult.	
Wabash R.R., Mar., 1898	Phos. specified for each order.						52,000 60.000	60,000 70,000	48,000 60,000	½ ult.	½ ult.	½ ult.
Pencoyd Iron Works, April, 1895	.08				O. H.		50,000 60,000	60,000 70 000		½ ult.	½ ult.	
N. Y. N. H. & H. R.R., 1894	.06	.05		.45			56 000 64,000		50,000 54,000	35,000		
Chicago & Alton, Oct., 1897	.08A .04B						54,000 62,000	62 000 70,000	48,000 56,000	½ ult.	½ ult.	½ ult.
Philadelphia & Reading	.07A .04B						57,000 65,000		Not over 60 000	54% ult.		
Plant System Rys., June 2, 1896	.08						52.000 62,000	60,000 68,000		34,000	36,000	
Robert Moore	.08A .04B						56,000 66,000					
Southern Indiana R.R. Co.	.08A .04B	.10			Bess phos .06 Rivets sul. .06		54,000 62,000	60,000 68,000	48,000 58,000	30.000	34,000	23,000
Chesapeake & Ohio, Feb., 1896	.08A .05B						52.000 60,000	60,000 68,000		30,000	35,000	
Boston Elevated Ry., 1898	.08A .04B	.05 ...			Rivets phos. .03		48.000 56,000	60,000 68.000		30,000	½ ult.	

C., C., C. & St. L.—Specifications practically same as B. & O. S. W. for quality. C.R. I. & P. and Chicago & Western Indiana, same as Chicago & Alton. Lehigh

SYNOPSIS OF SPECIFICATIONS FOR ROLLED STEEL.

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION INTERNATIONAL ASSSOCIATION FOR TESTING MATERIALS.

Physical requirements.																		
h.	Elongation, % in 8 in.			Reduction of area, %.			Bending. {H. = hot. C. = cold, D. = diameter. Q. = quench.			Drift test diameter to be increased.	Pins.	Variation in weight, %.		
	Soft.	Medium.	Rivet.	Soft.	Medium.	Rivet.	Soft.	Medium.	Rivet.			Sections.	Entire order.	
	½ ult.	25	22	26	.....	....	....	180° flat	180° D. = t	180° flat	.....	Reduce el. 5%	2½ except plts.	.....	5,000
	....	25	22	26	.....	....	....	.....	.....	.....	.....	"	.....	.....	
	....	25	20	....	50	40	..	180° flat C., Q.	180° D. = t C., Q.	.....	Soft 100% Med. 50%	el. 5% Red. 10% } Less.	.....	2½	
	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	20	.....	.....	.....	....	180° flat Thick 180%	Material over 1 in. D. = 1½ in. t	C.	100% Punch test.	Medium el. 16%	2½	.....	
	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	23	.....	50	43	....	180° flat C., Q.	180° D. 1½ in. t C., Q.	.....	Hammer test	.....	2½	.....	
	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.	.....	20	26	.....	.....	....	.....	180° D. = t C.	180° flat C. 100° t = Q.	.....	Reduce el., 5%	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
d	less.	25	20	....	.....	.....	....	180° flat C.	180° D. = t C.	.....	50%	.....	2 to 8 for plts.	2	56,000
n.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60,000
	.....	26	24	.....	50	40	..	180° flat C.	180° flat C.	.....	.....	.....	2½ to 8 for plts.	.....	56,000
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Hammer test	.....	.....	.....	60,000
	½ ult.	25	22	26	.....	.....	..	180° D. = t C. & Q.	180° D. 1½ in. t C. & Q.	180° flat	33⅓%	el., 15%	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.	26	22	26	.....	.....	....	180° flat C.	180° D. = t C.	180° flat C.	....	Reduce el., 5%	2½	.....	Bel
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.		1.500000 ÷ ult.		.....	.....	....	180° flat C. 180° D. = t C.	½ in. t or less over ½ in. t	180° flat C.	50%	Reduce el., 5%	2½	2	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.		1.500000 ÷ ult.		.....	.....	....	180° flat C. 180° D. = t C.	½ in. t or less over ½ in. t	180° flat C.	50%	Reduce el., 5%	2½	2	Bel
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	28	20	.....	50	44	....	180° D. = t C. & Q.	180° D. = t C & Q.	.....	80%	.....	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	....	25	22	....	50	40	....	180° flat C.	180° D. = t C.	.....	.....	Reduce el., 5%, Red., 10%	2½	.....	Specim qual
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	28	.....	.....	45	.....	....	180° flat C.	.....	.....	50%	.....	.....	.....	Order spec
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	22	.....	50	40	....	180° flat	180° D. = t	.....	100% Punch test	.....	.....	.....	Min.
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	25	28	50	45	55	180° flat C.	180° D. = t C.	180° flat	soft 50%	.....	2½ above 1½ below	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	22	.....	.....	.....	....	180° flat	180° D. = t	.....	38.7%	Reduce el , 10%	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	24	.....	50	45	....	180° flat C., & Q.	180° D. = t C. & Q.	.....	66⅔%	....	2½ except plts.	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	20	.....	50	40	....	180° flat C., & Q.	180° D. = t C & Q.	.....	.....	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Hammer test	.....	.....	.....	
	55% ult.		1.500000 ÷ ult.			2.800000 ÷ ult.		180° flat	180° flat	180° flat	50%	.....	2½ down to 5 for plts.	.....	60
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54
	28,000	25	17	28	50	40	56	180° flat C.	C. 180° D. = t C.	C. 180° flat C.	50%	.....	2½ except extra wide plts.	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	24 to 20	.....	48	36	....	180° flat H., C., Q.	180° D. = t H., C., Q.	.....	50% med. 25% high	.....	2 up to 8 for plts.	1 to 2	56,000, 60,000,
	.....	.....	20	.....	.....	40	.....	.....	.....	.....	100%	.....	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	22	.....	.....	.....	....	180° flat C.	180° D. = 1½ in. t H., C., Q.	.....	50%	Reduce el., 5%	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	22	.....	50	42	...	180° flat C.	180° D. = t over ½ in. D. = 1½ in. t	.....	50%	.....	.....	.....	56,000, 54,000
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	.....	22	26	.....	...	50	.....	180° D. = 2 in. H., C., Q.	180° flat C.	33⅓%	el., 16%	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	22	.....	50	40	....	180° flat C.	180° D. = t	.....	.....	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	55% ult.	26	22	28	.....	.....	...	180° flat C.	180° D. = t C.	180° flat C.	30%	Reduce el., 5%	2½ except wide plts.	.....	5 5
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	27	26 See remarks	.....	55	50	...	180° flat	180° flat	.....	.....	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	23,000	25	22	26	40	40	45	180° flat	180° D. = t	180° flat C.	50%	.....	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	22	.....	50	44	....	180° D. = 1½ in. t C. & Q.	180° D. = 1½ in t C. & Q.	.....	50%	.....	2½ except plts.	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.	25	22	26	50	45	50	180° flat	180° D. = t H., C., Q.	180° flat	50%	.....	2½	2	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	26	22	.....	.....	.....	..	150° flat	180° D. = 2 in. H., C., Q.	.....	33⅓%	Reduce el., 5%	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.. ....	25	.....	30	50	..	60	180° flat C. 180° D. = 1¼ in. C.	1 in. t or less over 1 in. t	Quench Bend 180° D. t	50% Punch test	Reduce el., 5%	2½	...	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	½ ult.	28	22	28	.....	.....	...	180° flat H., C.	180° D. = t H., C.	180° flat H., C.	.....	el., 10%	2½ except	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	plts. over 40 in.	.....	
	.....	25			.....	.....	.....	180° D. = 2 in.	.....	180° flat	33%	.....	2½	.....	
	.....	22 plts. over 16 in. wide.			.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	20 " " 42 " "			..	...	....	H., C., Q.	.....	.....	.....	.....	.....	.....	
	.... ..	26	20	.....	50	45	....	180° flat C. & Q.	180° D. = 2 in. t C. & Q.	.....	100% soft 66⅔% med.	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	.....	.....	.....	.....	....	180° D = t Q.	.....	.....	.....	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	23,000	25	22	26	50	45	50	180° D. = t C.	180° D. = t	180° D. = t C. 180° flat Q.	37.5% soft 25% med.	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	25	20	.....	.....	.....	....	180° flat C. & Q.	180° D = 1½ in. t C. & Q.	.....	.....	.....	.....	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	.....	28	22	....	50	40	....	180° flat C.	180° D. = t Q.	.....	50%	.....	2½	.....	
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	

Lehigh Valley same as Theo. Cooper's. New York, Chicago & St. Louis and Cleveland, Lorain & Wheeling. January, 1900, same as Osborn's Railway. New York. Ontar

SYNOPSIS OF SPECIFICATIONS FOR ROLLED STEEL.

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION INTERNATIONAL ASSSOCIATION FOR TESTING MATERIALS.

Physical requirements.									Variation in weight, %.		Require
n 8 in.	Reduction of area, %.			Bending. {H. = hot. C. = cold, D. = diameter. Q. = quench.			Drift test diameter to be increased.	Pins.	Sections.	Entire order.	Tensile strength, lbs. per sq. in.
Rivet.	Soft.	Medium.	Rivet.	Soft.	Medium.	Rivet.					
26	.....	....	....	180° flat	180° D. = t	180° flat	.....	Reduce el. 5%	2½ except plts.	.....	5,000 below min. for spec.
26	...			.....	.....	.....	.....	"			
....	50	40	...	180° flat C., Q.	180° D. = t C., Q.	....	Soft 100% Med. 50%	el. 5% Red. 10% } Less.	....	2½	58,000
.....	.....	.....	.....	180° flat Thick 180%	Material over 1 in. D. = 1½ in. t	C.	100% Punch test.	Medium el. 16%	2½	.....	58,000
.....	50	43	....	180° flat C., Q.	180° D. 1½ in. t C., Q.	....	Hammer test	....	2½	.....	58,000
26	.....	.....	....	.....	180° D. = t C.	180° flat C. 100° t = Q.	....	Reduce el., 5%	.....	.....	.....
.....	.....	.....	....	180° flat C.	180° D. = t C.	....	50%	.....	2 to 8 for plts.	2	56,000. 2 in and over 60,000. 1 in. and under
.....	50	40	..	180° flat C.	180° flat C.	....	Hammer test	....	2½ to 8 for plts.	.....	56,000. 2 in. and over 60,000. 1 in. and under
26	.....	.....	..	180° D. = t C. & Q.	180° D. 1½ in. t C. & Q.	180° flat	33⅓%	el., 15%	2½	.....	56,000
26	.....	.....	....	180° flat C.	180° D. = t C.	180° flat C.	.....	Reduce el., 5%	2½	.....	5 000 Below specimen
lt.	.....	.....	....	180° flat C. 180° D. = t C.	½ in. t or less over ½ in. t	180° flat C.	50%	Reduce el., 5%	2½	2	.....
lt.	.....	.....	....	180° flat C. 180° D. = t C.	½ in. t or less over ½ in. t	180° flat C.	50%	Reduce el., 5%	2½	2	5,000 Below specimen
.....	50	44	....	180° D. = t C. & Q.	180° D. = t C & Q.	.....	80%	.....	.....	.....	54,000
....	50	40	....	180° flat C.	180° D. = t C.	.....	.....	Reduce el., 5%, Red., 10%	2½	.....	Specimen tests cut from ann quality
.... ..	45	.....	....	180° flat C.	.....	.....	50%	.....	.....	.....	Order material to give same specimen
.....	50	40	....	180° flat	180° D. = t	.....	100% Punch test	.....	.....	.....	4,000 below Min. for specimen
28	50	45	55	180° flat C.	180° D. = t C.	180° flat	soft 50%	.....	2½ above 1½ below	....	58,000
.....	.....	.....	....	180° flat	180° D. = t	.....	38.7%	Reduce el , 10%	2½	.....	57,000
.....	50	45	....	180° flat C., & Q.	180° D. = t C. & Q.	.....	60⅔%	.....	2½ except plts.	....	53,000
.....	50	40	....	180° flat C., & Q.	180° D. = t C & Q.	.....	Hammer test	.....	2½	.	56,000
lt.	2.800000 ÷ ult.			180° flat	180° flat	180° flat	50%	.....	2½ down to 5 for plts.	.....	$63{,}000 - \frac{9\,000\ A}{P}$
.....	.....	.....	....	C.	C.	C.	.....	.....	.....	.....	$54\,000 - \frac{8{,}000\ A}{P}$
28	50	40	56	180° flat C.	180° D. = t C.	180° flat C.	50%	.....	2½ except extra wide plts.	....	48,000
... ..	.....	.....	....	180° flat	180° D. = t	.....	50% med.	....	2 up to	1 to	56,000. 2 in. and over
....	48	36	....	H., C., Q.	H , C., Q.	.....	25% high	....	8 for plts.	2	60,000, 1 in. and under
.....	.....	40	....	.....	.....	.....	100%	.....	.....	.....	58 000 to 65,000
.....	.....	.....	....	180° flat C.	180° D. = 1½ in. t H., C., Q.	.....	50%	Reduce el., 5%	2½	....	58 000 56,000
.....	50	42	...	180° flat C.	180° D. = t over ½ in. D. = 1½ in. t	....	50%	.....	.....	.....	56,000. 6 in. sq. & less 54,000 over 6 sq. in.
26	.....	...	50	.....	180° D. = 2 in. H., C., Q.	180° flat C.	33⅓%	el.. 16%	.....	....	56,000
.....	50	40	....	180° flat C.	180° D. = t	.....	.....	.....	2½	....	55,000 to 65,000
28	.....	.....	..	180° flat C.	180° D. = t C.	180° flat C.	30%	Reduce el., 5%	2½ except wide plts.	.....	52,000 soft 56,000 med.
.....	55	50	...	180° flat	180° flat	.....	.....	.....	2½	.....	.....
26	40	40	45	180° flat	180° D. = t	180° flat C.	50%	.....	.....	.....	.....
.....	50	44	....	180° D. = 1½ in. t C. & Q.	180° D. = 1½ in t C. & Q.	.....	50%	.....	2½ except plts.	.....	.....
26	50	45	50	180° flat	180° D. = t H., C., Q.	180° flat	50%	.....	2½	2	58,000
.....	.....	.....	..	180° flat	180° D. = 2 in. H., C., Q.	.....	33⅓%	Reduce el., 5%	2½	.....	.....
30	50	..	60	180° flat C.	1 in. t or less over 1 in. t	{Quench {Bend 180° D. t	50% Punch test	Reduce el., 5%	2½	.....	.....
28	.....	.....	....	180° D. = 1¼ in. C.	180° D. = t	180° flat	.....	el., 10%	2½ except	.....	58 000
.....	.....	.....	....	180° flat H., C.	H., C.	H., C.	.....	.....	plts. over 40 in.	.....	.....
, wide.	....	.....		180° D. = 2 in.	.....	180° flat	33⅓	.....	2½	.....	.....
"	.....	.....	....	H., C., Q.	.....	.....	.....	.....	.....	.....	.....
.....	50	45	....	180° flat C. & Q.	180° D. = 2 in. t C. & Q.	.....	100% soft 66⅔% med.	.....	2½	.....	56,000
.....	.....	.....	....	180° D = t Q.	.....	.....	.....	.....	2½	.....	.....
26	50	45	50	180° D. = t C.	180° D. = t	180° D. = t C. 180° flat Q.	37.5% soft 25% med.	.....	2½	.....	52,000 soft 58,000 med.
.....	.....	.....	....	180° flat C. & Q.	180° D = 1½ in. t C. & Q.	.....	.....	.....	.....	....	60,000 med. 52,000 soft
.....	50	40	....	180° flat C.	180° D. = t Q.	.....	50%	.....	2½	....	.....

eo. Cooper's. New York, Chicago & St. Louis and Cleveland, Lorain & Wheeling. January, 1900, same as Osborn's Railway. New York. Ontario & Western and Pittsl

Requirements full-sized eye bars.

Elastic limit, lbs. per sq. in.	Elongation, %.	Breakage.	Remarks.
.....	10 body of bar.	Not more than ⅛ to break in head.	Eye bar matl over 1½ in. thick; reduce elong. 1% for each ⅛ in. increase in thickness down to 20% for med. and 22% for soft.
32,000	15 in 10 ft.	....	Soft steel web plts. over 33 in. wide may have 20% elong. and 40% reduction.
½ ult.	13 in 20 ft.	....	Opening and closing tests for angles.
	Down to 8 for longer lengths.		
29,000	18 in 12 in.	Red. 40%.	
.....	12 balance.	....	
....	....	....	
....	....	....	
½ ult.	14 in 10 ft.	All bars must break in body.	
50% ult. 2 in. over 55% ult., 1 in. under	14 in 10 ft.	.....	
.....	10	Not more than ⅛ to break in head.	Eye bar material over 1½ in. thick reduce elongation 1% for each ⅛ in. increase in thickness down to 20%.
....	10 in 15 ft.	Not more than ⅛ to break in head.	Eye bar mater al over 1½ in. thick reduce elongation 1% for each ⅛ in. increase in thickness down to 20% for med. and 22% for soft.
....	....	Not more than ⅛ to break in head.	T. S. to average within 2,500 lbs. of 52,000 and 60,000 for rivet and balance respectively. Opening and closing tests for angles.
....	15 in 15 ft.	Not more than ⅛ to break in head.	T. S. to average within 2,500 lbs of 52,000 lbs. and 64,000 lbs. for rivets and balance respectively. Opening and closing tests for angles.
28,000	10	.....	
from annealed bars to determine		Not more than ⅛ to break in eye.	High steel T. S. 66,000 to 76,000 lbs., el. 18% in 8 in., reduce 35% C. B. 180° D. = 3 t.
ive same results as	15	....	
⅛ ult.	13 in 20 ft.	....	
33,000	10 in 20 ft.	.....	Rollers and roller plts.—T. S. 70,000 to 78,000 lbs. el. 22% in 8 in.
.....	12 in 20 ft.	....	
.....	15 in 10 ft.	.....	
.....	15 in 10 ft.	.....	
55% ult.	2 in 10′ med. 14 in 10′ soft	Not more than ⅛ to break in eye.	
27,000	14 in 10 ft.	Not more than ⅛ to break in eye.	
50% ult., 2 in. over 55% ult., 1 in. under	14 in 10 ft.	Not more than ¼ to break in eye.	High Steel { El., 40,000 lbs. red. 38 to 30% T. S. 70 to 80,00 lbs., el., 22 to 18% in 8 in. Q bend. | Med. phos. .06A to .04B, Sul. .05, Sil. .05, Mn. .70, High phos. .07A, Sul. .05, Sil. .06, Mn. .80.
32,000	10 in 20 ft. Red. 40	Not more than ¼ to break in eye.	
30,000	15 in 20 ft.	For bars 8 sq. in. and less.	Not more than ⅛ of bar to break in head.
29,000	10 in 10 ft.	For bars over 8 sq. in. to 20	
½ ult.	15 in 10 ft.	Reduction 30 to 20%.	Opening and closing tests for angles.
28,000	10 in 10 ft.	All bars must break in body.	
½ ult.	10 in 20 ft. Red. 40	.....	
27,000 soft 33,000 med.	14 in 12 ft. average 16	Not more than ⅛ to break in eye.	El. for med. 26% for 57,000 lbs., T. S.—reduce ⅗% for each 1,000 lbs. down to 3
.....	.....	.....	High steel T. S. 66 to 74,000 lbs. el., 22%, red. 45%.
30,000	12 in 15 ft.	Red. 40%.	
.....	.....	.....	
½ ult.	10 in 10 ft.	Not more than ⅛ to break in eye.	Opening and closing tests for angles.
.....	10 in 10 ft.	Must break in body of bar.	
.....	.....	.....	Opening and closing tests for angles.
30,000	12 in 10 ft.	.....	
.....	.....	.....	
.....	.....	.....	
32,000	15 in 10 ft.	.....	
.....	.....	.....	
.....	.....	Not more than ⅛ to break in eye.	Punch tests.
.....	12½ med. 18 soft	.....	
.....	.....	.....	

and Pittsburg & Lake Erie, same as L. S. & M. S., except phosphorus may be .08 for A. or B., O.H.

SYNOPSIS OF SPECIFICATIONS FO

COMPILED FOR COMMITTEE No. 1.—AMERICAN SECTION, INTER

Name and Date.	Quality of steel.	Chemistry.								
		Phos.	Sul.	Tensile stren'h lbs. per sq. in.		Elastic limit, lbs per sq. in.	Elongation, per cent.	Reduction of area per cent.	Cold bend.	Quenc Bend
		Maximum.		Min.	Max.					
American Bureau of Shipping, 1899.	Bess. or O.H.	.....	.....	58,000	68,000	....	20	.. ....	.....	180° D =
Americ'n Steel Barge Co., 1897.....	O. H.	.08	.....	52,000	62 000	....	24	45	.....	.....
Pittsburg Steamship Co., 1899	Bess. O. H.	.10 .08	Shapes. Plates.	54,000	62,000	.....	24	45	.....	.....
American Ship Building Co , 1899.....	O. H.	.08 acid .04 basic	.....	52,000	60,000	.....	24	45	Per Lloyd's	
Detroit Dry Dock Co., 1897	O.H.	075	.....	52,000	60,000	½ ult.	25	45	.....	180° D =
U. S. Steamship Owners, Builders & Underwriters' Assoc., 1900.....	Bess. or O.H.	.....	.....	56,000	66,000	.....	18	.....	.....	180° D =
Lloyds...	.....	.....	.....	60,480	71,680	.....	20	. .. ..	Yes.	180° D =
Bureau Veritas.....	.....	.....	.....	62,720	71,680	.....	20	.....	.....	180° D =

Physical Properties.						Variation in weight, per cent.	
l.	Quench Bend.	Punch tests	Opening and closing tests for shapes.	Number of tensile tests.	Remarks.	Sections.	Entire order
..	180° D = 3 × t	.....	Yes.	Two per melt.	Material over 68,000 lbs. T. S. will not be rejected if elongation increases proportionately.		
..	....	. ..	.....	....	....	2½ plts. und. 20 lbs. 5%.	2½
..	.....	...	.....	....	....	Standard	
	Per Lloyd's	.....	....	....	....	2½	
..	180° D = 3 × t	Yes.	.....	One per melt.	....	.....	2½
.	180° D = 1½ × t	Yes.	Yes.	.....	Pieces with undressed edges to bend C. or Q. 120° D = 1½ × t. All tests may be long'l or trans. for plates. .... El. may be 16 per cent. for mat'l ¼-in thick.		
.	180° D = 3 × t	.....	.....	One each lot of 50 or less.			
..	180° D = 3 × t	.....	Yes.	One each lot of 50 or less.			

(*c*). For pins made from any of the three classes of steel, the required elongation shall be five per cent. (5%) less than that specified in paragraph No. 4, as determined on a test specimen the center of which shall be one inch (1") from the surface.

6. Eye-bars shall be of medium steel. Full-sized tests shall show 12 1/2 per cent. elongation in fifteen feet of the body of the eye-bar, and the tensile strength shall not be less than 55,000 pounds per square inch. Eye-bars shall be required to break in the body, but should an eye-bar break in the head, and show twelve and one-half percent (12 1/2%) elongation in fifteen feet and the tensile strength specified, it shall not be cause for rejection, provided that not more than one-third (1/3) of the total number of eye-bars tested break in the head.

Tensile Tests of Eye-bars.

7. The three classes of structural steel for bridges and ships shall conform to the following bending tests; and for this purpose the test specimen shall be one and one-half inches wide, if possible, and for all material three-fourths inch (3/4") or less in thickness the test specimen shall be of the same thickness as that of the finished material from which it is cut, but for material more than three-fourths inch (3/4") thick the bending test specimen may be one-half inch (1/2") thick:

Bending Tests

Rivet rounds shall be tested of full size as rolled.

(*d*). Rivet steel shall bend cold 180° flat on itself without fracture on the outside of the bent portion.

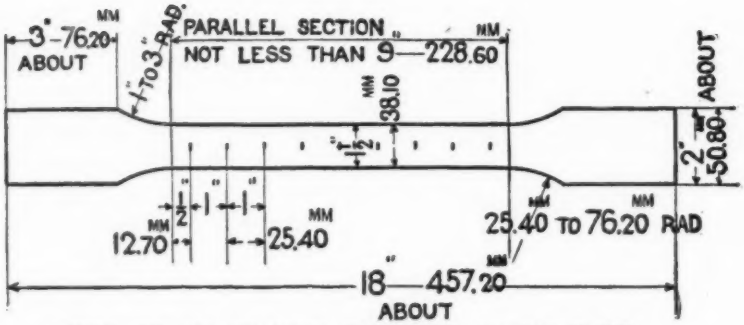
(*e*). Soft steel shall bend cold 180° flat on itself without fracture on the outside of the bent portion.

(*f*). Medium steel shall bend cold 180° around a diameter equal to the thickness of the specimen tested, without fracture on the outside of the bent portion.

Test Pieces and Methods of Testing.

8. The standard test specimen of eight inch (8") gauged length, shall be used to determine the physical properties specified in paragraphs Nos. 4 and 5. The standard shape of the test specimen for sheared plates shall be as shown by the following sketch:

Test Specimen for Tensile Test.



For other material the test specimen may be the same as for sheared plates, or it may be planed or turned parallel throughout its entire length and in all cases where possible, two opposite sides of the test specimens shall be the rolled surfaces. Rivet rounds and small rolled bars shall be tested of full size as rolled.

Number of Tensile Tests.

9. One tensile test specimen shall be taken from the finished material of each melt, but in case this develops flaws, or breaks outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor.

Test Specimens for Bending.

10. One test specimen for bending shall be taken from the finished material of each melt as it comes from the rolls, and for material three-fourths inch (3/4") and less in thickness this specimen shall have the natural rolled surface on two opposite sides. The bending test specimen shall be one and one-half inches (1 1/2") wide, if possible, and for material more than three-fourths inch (3/4") thick the bending test specimen may be one-half inch (1/2") thick.

(*g*). The bending test may be made by pressure or by blows.

Annealed Test Specimens.

11. Material which is to be used without annealing or further treatment shall be tested for tensile strength in the condition in which it comes from the rolls. For material which is to be annealed or otherwise treated before use, a full-sized section of tensile test specimen length, shall be similarly treated before cutting the tensile test specimen therefrom.

12. For the purpose of this specification, the yield point shall be determined by the careful observation of the drop of the beam or halt in the gauge of the testing machine. **Yield Point.**

13. In order to determine if the material conforms to the chemical limitations prescribed in paragraph No. 2 herein, analysis shall be made of drillings taken from a small test ingot. **Sample for Chemical Analysis.**

VARIATION IN WEIGHT.

14. The variation in cross section or weight of more than 2 1/2 per cent. from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations:

(*h*). Plates 12 1/2 pounds per square foot or heavier, when ordered to weight, shall not average more than 2 1/2 per cent. variation above or 2 1/2 per cent. below the theoretical weight.

(*i*). Plates under 12 1/2 pounds per square foot, when ordered to weight, shall not average a greater variation than the following:

Up to 75 inches wide, 2 1/2 per cent. above or 2 1/2 per cent. below the theoretical weight.

75 inches and over, 5 per cent, above or 5 per cent. below the theoretical weight.

(*j*). For all plates ordered to gauge, there will be permitted an average excess of weight over that corresponding to the dimensions on the order equal in amount to that specified in the following table:

TABLE OF ALLOWANCES FOR OVERWEIGHT FOR RECTANGULAR PLATES WHEN ORDERED TO GAUGE.

The weight of 1 cubic inch of rolled steel is assumed to be 0.2833 pound.

Plate 1/4 inch and over in thickness.

Thickness of plate. Inch.	Width of plate. Up to 75 inches. Per cent.	75 to 100 inches. Per cent.	Over 100 inches. Per cent.
1/4	10	14	18
5/16	8	12	16
3/8	7	10	13
7/16	6	8	10
1/2	5	7	9
9/16	4 1/2	6 1/2	8 1/2
5/8	4	6	8
Over 5/8	3 1/2	5	6 1/2

Plates under 1/4 inch in thickness.

Thickness of plate. Inch.	Width of plate. Up to 50 inches. Per cent.	Width of plate. 50 inches and above. Per cent.
1/8 up to 5/32	10	15
5/32 " 3/16	8 1/2	12 1/2
3/16 " 1/4	7	10

FINISH.

15. Finished material must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

BRANDING.

16. Every finished piece of steel shall be stamped with the melt number, and steel for pins shall have the melt number stamped on the ends. Rivets and lacing steel, and small pieces for pin plates and stiffeners, may be shipped in bundles, securely wired together, with the melt number on a metal tag attached.

INSPECTION.

17. The inspector representing the purchaser, shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.